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ABSTRACT

The performance-based assessment was developed to assess students' higher order thinking skills in real-life problem-solving situations in Alberta, Canada. These tasks assess aspects of science that cannot be measured easily by regular paper and pencil tests. The purpose of this document is to provide teachers, administrators, students, and parents with samples of students' performances that exemplify standards in relation to the 1994 Grade 6 Science Performance-Based Assessment Tasks. Thirty-one schools were randomly selected to participate in this assessment. From these schools, 698 randomly selected students did the performance-based assessment. The activities allowed students to implement a variety of strategies with hands-on materials, and to collect information. Students were asked how they carried out these strategies to solve problems. Their responses provided another picture of what they knew and were capable of producing. The samples of students' work selected for this booklet illustrate the provincial standards for Grade 6 science students at three levels: the Standard of Excellence; the Acceptable Standard; and Not Yet At the Acceptable Standard. The commentaries that accompany the samples highlight selected features of the students' responses and show how the scoring criteria relate to students' work. Appendixes include mathematics holistic scoring criteria and percentage of students at each level. (JRH)

Samples of Student Responses

from the Grade 6 Science Performance-based Assessment Tasks

June

Students First! Student Evaluation

Alberta Education

ALBERTA EDUTION CATALOGUING IN PUBLICATION DATA

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This document was written primarily for:

Students	
Teachers	✓
Administrators	
Parents	
General Public	
Others (Specify)	

Distribution: Superintendents of Schools • School Principals and Teachers • The Alberta Teachers' Association • Alberta School Boards Association • Alberta Education

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Introduction

Purpose

The purpose of this document is to provide teachers, administrators, students, and parents with samples of students' performances that exemplify standards in relation to the 1994 Grade 6 Science Performance-Based Assessment Tasks. The commentaries that accompany the samples highlight selected features of the students' responses and show how the scoring criteria relate to students' work.

Science Assessment in 1994

The Grade 6 Science assessment in 1994 collected information and reported on a range of learning expectations. Three instruments were used to collect information: the achievement test, a survey of student attitudes, and performance-based assessment tasks. Provincial results for the achievement test are available in the *Assessment Highlights* document. The performance-based assessment component is the specific focus of this booklet.

Selection of Samples

The samples of students' work selected for this booklet were used for training markers during the July 1994 marking session of the performance-based assessment. As such, these examples illustrate the provincial standards for Grade 6 science students at three levels: the Standard of Excellence, the Acceptable Standard, and Not Yet At the Acceptable Standard.

Confirming Standards

The initial work of confirming the standards that would govern the scoring of student performances was undertaken by a group of experienced Grade 6 Science teachers on June 25 and 26, 1994. Their task was to read a large enough sample of student responses to select those that exemplified the different levels of performance. At the same time, these teachers suggested adjustments to the standard descriptions in the scoring guide, where needed, and prepared specific notes for use by group leaders during the marking session. The Holistic Scoring Criteria are given in Appendix A.

These teachers later served as group leaders during the marking session. They used the selected examples to set the scoring guidelines and to train teachers for the marking session.

Marking

Teachers were selected for marking on the recommendation of their superintendents. All markers were teaching Grade 6 Science in the same school year that performance-based assessment was administered, and had done so for at least two years.

Markers followed the agreed-upon standards when scoring student responses. During the marking session, each marker scored a student's response for problem-solving skills and communication skills. The overall results are given in Appendix B.

General Description of the Performance-Based Assessment

Background

The performance-based assessment was developed to assess students' higher order thinking skills in real-life problem-solving situations. The tasks assessed aspects of science that cannot be measured easily by regular paper and pencil tests.

The activities allowed students to implement a variety of strategies with hands-on materials, and to collect information. Students were asked to explain the strategies they used and how they carried out these strategies to solve problems. Their responses provided another picture of what they knew and were capable of producing.

Performance-based Assessment
Program Area Emphasis by Topic

Activity	Activity Name	Topic	Learner Expectation
1	Tree Trunk	Living Things and the Environment	Observe a cross-section of a tree trunk Infer age of the tree Infer weather conditions during the lifespan of the tree
2	Ecosystem Mystery	Living Things and the Environment	Observe a model demonstrating interaction of living things, including a predator/prey relationship Infer from evidence provided in the model
3	Leaky Faucet	Matter and Energy	Collect information from a model of a leaky tap Design an experiment and control variables in determining the amount of water lost from the tap Calculate, using multiple steps, total water lost from the tap.
4	Wiring a Train Station	Matter and Energy	Construct a working model of lights, using switches in a variety of arrangements Make drawings of models designed
5	Musical Instrument	Matter and Energy	Construct models to demonstrate variables controlling frequency of vibrations. Communicate procedures through drawings and/or writing
6	Rockets, Gliders, and Kites	Earth, Space and Time	Make measurements of wind speeds using simple instruments Interpret data and draw inferences about activities influenced by wind speed

Sampling

Thirty-one schools were randomly selected to participate in this assessment. From these schools, 698 randomly selected students did the performance-based assessment.

Administration

This assessment was administered by trained assessors who followed standardized procedures. The assessment consisted of six real-life problems presented at six stations. Each station consisted of:

- a student activity sheet listing the problem, materials that could be used, and instructions
- materials

Three circuits, each with six stations, were set up. A maximum of 15 students were assigned to each session. This allowed five students to work through the six activities at each circuit. Students were given as much time as necessary to complete the tasks. Typically, between 1½ and 2 hours was needed for each student to complete the six tasks. Students recorded all of their work in a booklet.

The assessment took place between May 25 and June 4, 1994. The schools selected provided excellent cooperation in making space and tables available for this assessment.

Samples of Students' Performance

Activity 1—Tree Trunk

PROBLEM STATEMENT:

Tom and Mary are holidaying at a cabin by a lake. One night stormy winds blow over a tree. As they help their father and mother cut the tree into smaller pieces, they notice growth rings. Their father tells them that they can determine the past growing conditions by looking at the trunk cross-section. Their mother, who works as a forester with the government, told them that some of the information the cross-sections of the tree could give them includes:

1. the age of the tree—one ring equals one year of growth
2. when the tree started growing
3. if other living organisms lived in the tree
4. the types of growing conditions--there are wider rings if growing conditions were good

Also, there are many other things it could tell them. Use the cross-section of the tree trunk to tell about this tree.

YOU SHOULD HAVE:

1 tree cross-section
1 magnifying glass
1 ruler

INSTRUCTIONS:

- Use the materials to find out as much as you can about this tree. Record your observations and inferences in your Student Booklet. Answer the questions in your Student Booklet.

DEFINITIONS:

- Observing or making observations

  Using the senses (smelling, tasting, seeing, hearing, and touching) to get information about things or happenings where you are.

- Inferring

  An inference is an explanation for an observation. You give a reason for something you observe.

This solution was scored "At the Standard of Excellence."

Commentary

The responses indicate a thorough understanding of the problem. Extensive and accurate observations are made regarding the number of rings and diameter of the tree trunk. The conclusions drawn clearly show an understanding between observation and inference.

The interpretations and explanations are logical and are communicated effectively.

Activity 1—Tree Trunk

Follow the instruction sheet at this station

1. Record your observations and inferences here.

Observations	Inferences
- I observe small rings getting wider as they reach the middle of the tree.	- Because the wood smells I infer that it is rotting.
- The color is a dark yellowish brown in the middle.	- Because of the darker yellow color I infer it is rotting.
- The bark is a dark brown	- I think the tree is 11 years old because of the number of rings.
- The bark is rough	
- The wood is smooth.	
- The other side of the wood is	
- The piece of wood is a circle, 9cm long and 9½ cm wide.	
- It smells like [illegible]	
- There are 11 rings in the wood.	

2. How old is the tree and what year did it start growing? How do you know?

The tree is 41 years old and it started growing in 1953 because I substracted the number of rings from the year it is now.

3. What were the growing conditions for the first ten years of the tree's life?

The growing condition of the tree for the first 10 years was good. because the wider the rings the better growing conditions.

4. How healthy was the tree when it was blown over?

The tree wasn't healthy when it blew over.

5. What kind of tree was it and where did it probably grow?

I think the tree was a fir because of the bark. I think it come from a forest.

This solution was scored "Performance At the Acceptable Standard."

Commentary

The task is understood. There are appropriate inferences drawn from observations although some information is inaccurate. Any conclusions made are supported by observations and inferences.

The interpretations and explanations are logically and clearly stated.

Activity 1—Tree Trunk

Follow the instruction sheet at this station

1. Record your observations and inferences here.

Observations	Inferences
I used the magnifying glass to look at how many lines there were. There were 17 lines. I check if the rings were wider or thinner. To find the year the tree started growing I minused 1994 - 17 = 1977.	It would mean the cross section is 17 years of age. The rings were wide that means it had a good growing condition. The tree started growing in 1977 because its been growing for 17 years you minus it from 1994 and that was the year it started growing.

2. How old is the tree and what year did it start growing? How do you know?
The tree is 17 years old and it started growing in 1977. I know because I took 1994 and took away 17 years and it equaled seventeen.

3. What were the growing conditions for the first ten years of the tree's life?
The were very good because the rings were wider then the ones after 10 years

4. How healthy was the tree when it was blown over?
It was not healthy because it caused the the growing harder because the circulation was blown over so it couldn't get through enough to make it grow higher.

5. What kind of tree was it and where did it probably grow?
It looked like it was from a birch tree and it looked like it grew in the forest or in the woods.

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

The task is partially understood. An attempt is made to use observational skills, but there is little or no clear division between observations and inferences. There is some indication of incomplete and inaccurate conclusions possibly due to inaccurate observations.

The interpretation of information is not always clear, precise, or accurate.

Activity 1—Tree Trunk

Follow the instruction sheet at this station

1. Record your observations and inferences here.

Observations	Inferences
In it early years it needed a little more water but after about the ten years it finally got water.	The tree is round and is rough on one side and it is also rough on the outside of it.

2. How old is the tree and what year did it start growing? How do you know?

This tree here is about 15 years old and the year it started growing was 1979

3. What were the growing conditions for the first ten years of the tree's life?

In the first ten year it was going bad but the rest of it was going great!

4. How healthy was the tree when it was blown over?

When it blew over it was pretty healthy but it was to small.

5. What kind of tree was it and where did it probably grow?

The kind of tree was a spruce tree and it could grow on an open space like a back yard

Activity 2—Ecosystem Mystery

PROBLEM STATEMENT.

Kim and John are camping near Peter Lougheed Provincial Park. They go for a walk to the interpretive centre. There, a guide asked them to make observations of a miniature ecosystem set up in a box and then tell what happened in this ecosystem. Help Kim and John tell the story of what happened.

YOU SHOULD HAVE:

1 rectangular history box

INSTRUCTIONS:

- Help Kim and John tell the story by answering the questions in your Student Booklet.

DEFINITIONS:

- Observing or making observations—Using the senses (smelling, tasting, seeing, hearing, and touching) to get information about things or events.
- Inferring—An inference is an explanation for an observation. You give a reason for something you observe.

This solution was scored "At the Standard of Excellence."

Commentary

The task is analyzed and the problem is understood. All inferences are clearly linked to each accurate and extensive observation. The sequencing of events is clear and the inferences are supported by the observations. The inferences made reflect the kind of environment in a wetland ecosystem.

The observations and inferences are precise and the story line is connected in a logical way. All components are included and linked effectively.

Activity 2—Ecosystem Mystery

Follow the instruction sheet at this station

1. Record your observations and inferences here

Observations	Inferences
-bird feathers	-deer tracks
-pussy willows	mud on ground (dried)
-long thin tracks	fox tracks
-fat, rounded tracks	-bird tracks
-hoof-shaped tracks	-cracked surface
clay coloured ground	bird was killed by fox
tracks in ground	-deer ran by
-feathers are black,	-ground is dry
gray and brown	-hasn't rained in a while

2. Use your observations and inferences to tell the story of what happened

I think that pussy willows used to grow here but then the rain stopped for a long while + the pussy willows died. I think that earlier when the ground was wet, a fox walked through the mud, then a bird walked by but was killed and dragged off by the fox, and later on, a deer ran by. Later, the mud dried and all that was left were the pussy willow branches and tracks of animals to show that there may have been life there at one time

3. What kind of environment does this mystery box represent?

Give reasons to support your inferences.

- This mystery box represents a dry ecosystem because the soil is cracked and dry-looking.
- This box represents an ecosystem that had all the requirements of a good ecosystem: Sun, rain (water), plants and air. It also had: animals, and pussy willows. I can tell it had sun because the plants survived at one time. I can tell it had water because the dirt + water made mud, which caused the animals to leave tracks and it must have had air for the animals + plants to survive.

This solution was scored "At the Acceptable Standard."

Commentary

The response indicates evidence of making observations and inferences concerning the ecosystem. The observations are not extensive, but are appropriate. The sequence of events and identification of the ecosystem is clear but not always accurate.

The language used is appropriate and events are usually connected in a logical way.

Activity 2—Ecosystem Mystery

Follow the instruction sheet at this station

1. Record your observations and inferences here.

Observations	Inferences
-Bird and animal footprints -Bird feathers -Pusy willos -Sand -Some Pusy willos have been Steped on	-A bird was walking here -An animal was walking here -The bird and the animal had a fight -The branches fell of the plant near by

2. Use your observations and inferences to tell the story of what happened.

First there was a bird walking along the sand then one of the birds enimies came along. Then the birds enimy started chasing the bird. After a few minuets the bird was killed and some feathers were left behind.

3. What kind of environment does this mystery box represent?

Give reasons to support your inferences.

1. A fighting ground because of the feathers left.
2. A place were pusy willos grow.
3. A beach.
4. Some were animals walk.

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

The task is partially understood. There is limited linkage between observations and inferences. The sequencing of events is partially clear.

The words used are appropriate for an ecosystem, but many components are missing. The connection between some events is not clearly expressed.

Activity 2—Ecosystem Mystery

Follow the instruction sheet at this station

1. Record your observations and inferences here.

Observations	Inferences
feathers	
animal tracks:	
bird	
rabbit	
racoon	

2. Use your observations and inferences to tell the story of what happened.

To me it looks like a racoon, bird, and rabbit tracks. It looks like one of the animals was chasing the other one for food. and the bird got attacked by something by it. feathers.

3. What kind of environment does this mystery box represent?

Give reasons to support your inferences.

It looks like some where near a camping area because of the racoon prints, a beach because of the bird prints and a forest because of the rabbit prints.

Activity 3—Leaky Tap

PROBLEM STATEMENT:

Darlene is concerned about wasting resources in her home. She notices that a tap in the storage room is dripping water into the sink. Her brother Tim tells her that it has been dripping for the last 24 hours. Darlene thinks it should be fixed right away because it is wasting energy and resources. Tim doesn't think it is that important because not very much water is leaking from the tap. Darlene thinks a lot of water will be wasted and decides to do an experiment to show Tim how much water will be wasted in one day. Help Darlene with her problem.

YOU SHOULD HAVE:

1 bucket with a tap
1 drip bucket
1 bucket stand
1–250 mL measuring cup
1–500 mL measuring cup
1–1000 mL measuring cup
1 stop watch
1 calculator

INSTRUCTIONS:

- Design a way of finding the amount that was wasted in the past 24 hours.
- Start the drip by carefully turning fully on.
- If water costs $0.02 per litre, how much money was wasted in 24 hours.
- When you are finished, turn the tap off and pour the water back in the bucket.

Remember: You only have about 15 minutes to complete this activity.

This solution was scored "At the Standard of Excellence."

Commentary

The problem is analyzed and clearly understood. A successful implementation of strategy is evident and there is a logical sequence of mathematical steps. The answer is within a reasonable range and expressed correctly in dollars and litres.

All data and calculations are organized logically with results and explanations clearly expressed. The information is accurate.

Activity 3—Leaky Tap

Follow the instruction sheet at this station

1. Describe the method that you used to find the amount of water coming out of the tap.
what I did first was turn on the tap and the stop watch. After the first minute I recorded 135ml of water. Then I turned it on for another minute, which totalled 145ml. So I averaged them out to 140ml/min

2. How much water came out of the tap in 24 hours?
If 140ml of water are wasted in one minute, timsing it by 60min is 8400 ml of water wasted in an hour. Then I timsed 8400 by 24 to get 201,600ml of water wasted in a 24 hour period.

3. If water costs $0.02 per litre, how much money was wasted in 24 hours?
In 24 hours 201L and 600 ml of water is wasted. If water costs $0.02 per Litre the amount of money wasted would be $4.02. (not including the amount of mL wasted)

Check One

I used the calculator

✓ Yes No

This solution was scored "At the Acceptable Standard."

Commentary

The problem is understood and a definite strategy is implemented to measure the water and calculate the time. The answer is within a reasonable range and stated in an acceptable unit of measure.

All interpretations and explanations are clearly expressed. The calculations are accurate up to the last step.

Activity 3—Leaky Tap

Follow the instruction sheet at this station

1. Describe the method that you used to find the amount of water coming out of the tap.

The method I used is I timed the water dripping for 1 minute and timesed it by 60. Then I timesed that by 24.

2. How much water came out of the tap in 24 hours?

201600 ml or 201.6 liters came out of the tap.

3. If water costs $0.02 per litre, how much money was wasted in 24 hours?

There was $10080 dollars wasted in 24 minutes

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

The problem is partially understood since a strategy for measuring water is evident. There are some steps within the mathematical sequence that are missing and incorrect. A unit of time for water measurement is not used.

The information is partly complete, but contains some inaccuracies. The connection between the calculations is not clear.

Activity 3—Leaky Tap

Follow the instruction sheet at this station

1. Describe the method that you used to find the amount of water coming out of the tap.
I turned on the water, then measured each amount of water.

2. How much water came out of the tap in 24 hours?
22584 L came out of the tap.

3. If water costs $0.02 per litre, how much money was wasted in 24 hours?
$1,129,200

Check One

I used the calculator

✓ Yes No

Activity 4—Wiring a Train Station

PROBLEM STATEMENT:

Joe and Hilda are making buildings for their train set. The train station has a room with two light bulbs and a switch. Find ways to hook up the light bulbs and the switch.

YOU SHOULD HAVE:

1 train station house with a bulb in each of the two rooms and one switch in a doorway
6 wires and clips
1 battery pack

INSTRUCTIONS:

- Answer the questions in your Student Booklet.
- Disconnect the wires after completing this activity.

This solution was scored "At the Standard of Excellence."

Commentrary

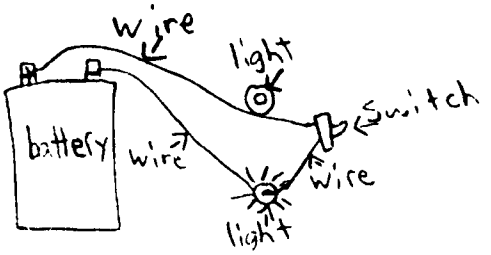
The response indicates a thorough understanding of how electrical circuitry is designed. An efficient and workable strategy is implemented, which supports a qualified solution.

The diagrams, with labelling, are clear and easy to understand. All of the circuits are workable, accurate, and complete.

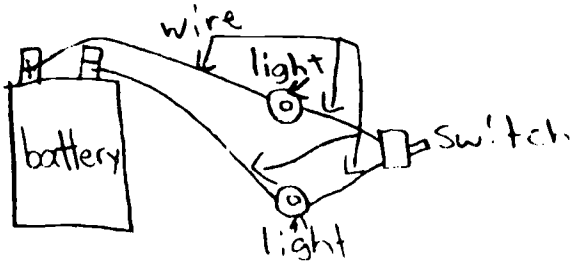
Activity 4—Wiring a Train Station

Follow the instruction sheet at this station

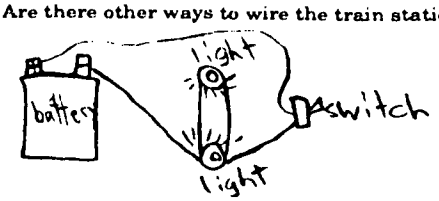
1. Wire the train station so that **one** light can be turned on and off by the switch. Draw a diagram showing how you wired the train station.

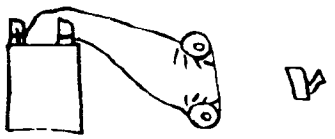


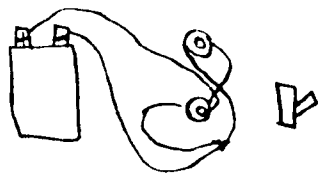
2. Wire the train station so that **both** lights can be turned off and on by the switch. Draw a diagram showing how you wired the train station.

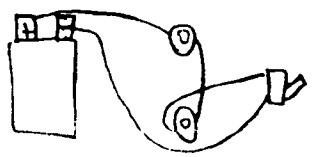


3. Are there other ways to wire the train station? Draw them.









This solution was scored "At the Acceptable Standard."

Commentary

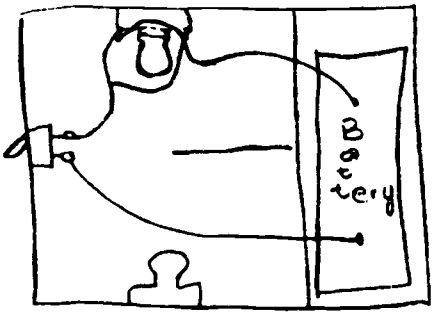
The response indicates an understanding of the problem because there is evidence of purposeful circuits. A workable strategy is developed that supports an appropriate solution.

The partially labelled diagrams, showing several circuits that work, are easy to understand. An organized system is used to display the information.

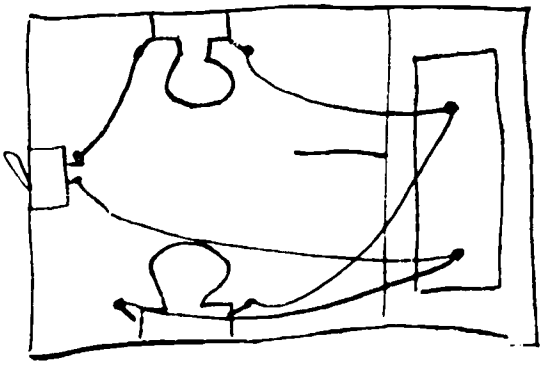
Activity 4—Wiring a Train Station

Follow the instruction sheet at this station

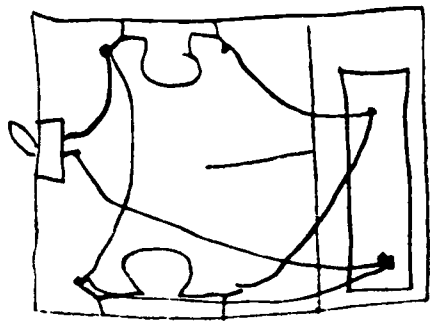
1. Wire the train station so that **one** light can be turned on and off by the switch. Draw a diagram showing how you wired the train station.



2. Wire the train station so that **both** lights can be turned off and on by the switch. Draw a diagram showing how you wired the train station.



3. Are there other ways to wire the train station? Draw them.



This way the lights never turn off

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

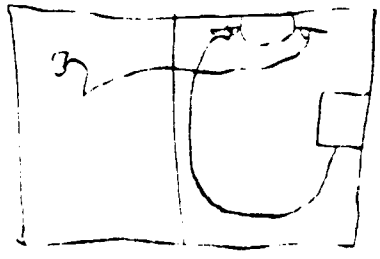
The task is partially understood. There is one circuit that works which reveals evidence of a plan.

The data is limited. One diagram is complete and the other has missing details. The diagrams are easy to understand without labelling.

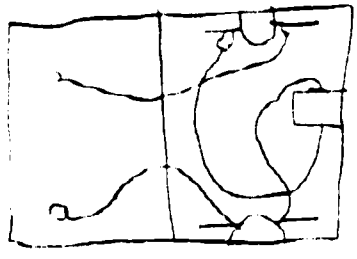
Activity 4—Wiring a Train Station

Follow the instruction sheet at this station

1. Wire the train station so that **one** light can be turned on and off by the switch. Draw a diagram showing how you wired the train station.



2. Wire the train station so that **both** lights can be turned off and on by the switch. Draw a diagram showing how you wired the train station.



Activity 5—Musical Instrument

PROBLEM STATEMENT:

Tasha wants to build a simple string instrument using materials she can find around the house. How could she build an instrument?

YOU SHOULD HAVE:

1 peg board
10 wooden pegs
1 bag with assorted elastic bands
4 pieces of wood
1 ruler

INSTRUCTIONS:

- Use these materials to build a stringed musical instrument that can make three different sounds.
- Answer the questions in your Student Booklet.

This solution was scored "At the Standard of Excellence."

Commentary

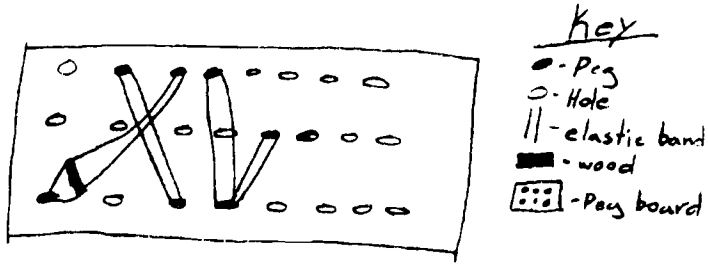
The task is completely analyzed and understood. An efficient and workable strategy is developed through the use of a logical and thorough approach. There is an efficient use of variables. The instruments are designed so the sounds can be altered.

The diagrams and descriptions are clear, logical, and complete, with precise reference made to the use of materials. The information is easily followed.

Activity 5—Musical Instrument

Follow the instruction sheet at this station

1. Draw diagrams showing what your string instrument looks like and describe how it makes different sounds.



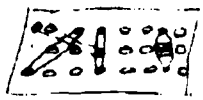
The way my instrument makes sounds is the vibrations. When the bands are plucked or strumed the band vibrates, producing sounds.

The sound of the bands depends on the lenghth. If the band is very short it will make a high sound. If it is long it will make a deeper sound.

The band must be stretched to make a sound.

2. Using any of the materials, how many different ways can you change the sound of your instrument? For each of your solutions draw a diagram and describe how you changed the instrument to make different sounds.

Name



This time I took out the wooden block from one of the bands. I placed one of the pegs in between two others with a band around them all. I moved one of the pegs to the outside corner increasing the space. Next I took a peg and just moved it outwards. Last I placed two new pegs on the board with two blocks of wood in between

When I took out the block the sound got deeper. After I placed the peg inbetween the others the sound seemed to stay the same. After I moved the peg to the outside corner the sound got higher and louder. When I moved a peg outward the sound got higher and louder.

Finnally when I placed the new equipment on the board they only seemed to bang the wood against the board.

This solution was scored "At the Acceptable Standard."

Commentary

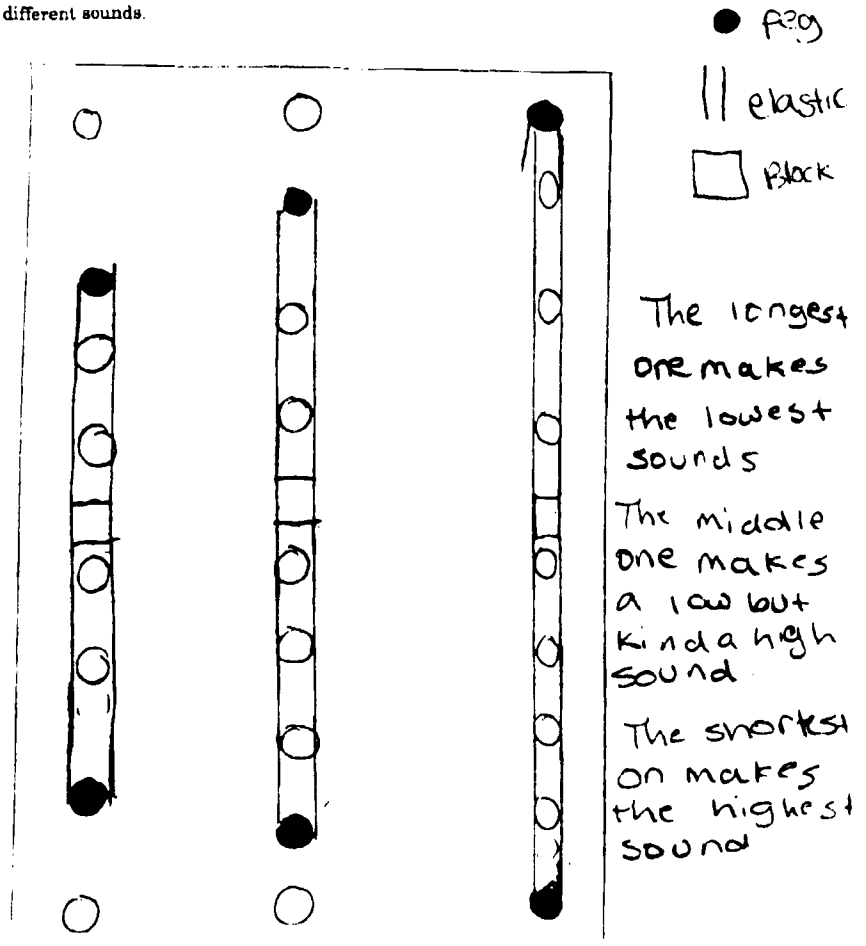
The task is understood. A musical instrument is successfully constructed which can alter sound. A workable strategy is developed.

The diagrams are mostly complete and labelled. The interpretations and explanations are clear and complete.

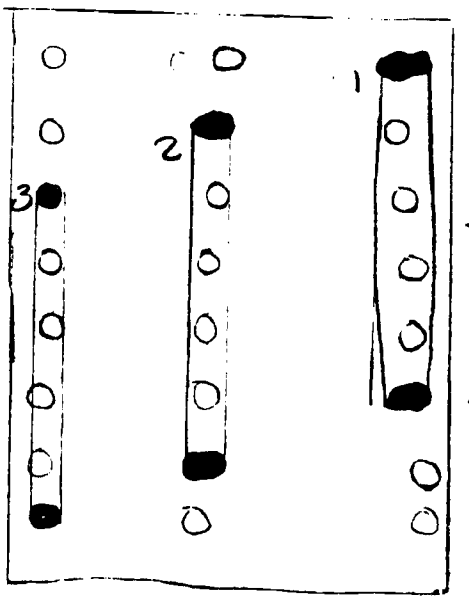
Activity 5—Musical Instrument

Follow the instruction sheet at this station

1. Draw diagrams showing what your string instrument looks like and describe how it makes different sounds.



2. Using any of the materials, how many different ways can you change the sound of your instrument? For each of your solutions, draw a diagram and describe how you changed the instrument to make different sounds.



The 1st one makes a low sound

The 2nd one makes a high sound

The 3rd one makes a low sound

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

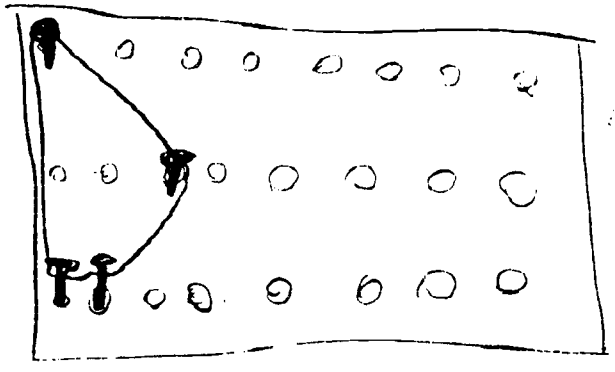
The task is partially understood but no inferences are made.

The diagrams and descriptions are limited and incomplete and diagram labels are missing.

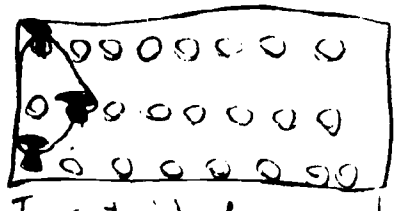
Activity 5—Musical Instrument

Follow the instruction sheet at this station

1. Draw diagrams showing what your string instrument looks like and describe how it makes different sounds.



2. Using any of the materials, how many different ways can you change the sound of your instrument? For each of your solutions, draw a diagram and describe how you changed the instrument to make different sounds.



I got rid of one and moved one closer to the other two.

Activity 6—Rockets, Gliders, and Kites

PROBLEM STATEMENT:

Peter and Jane are interested in things that fly. They enjoy launching model rockets, flying gliders, and flying kites. On a Saturday afternoon, Peter and Jane, and their parents go to a large field. They use a wind speed indicator to measure the wind speed. They do this because the wind speed is different in various parts of the field. They use a wind speed chart to choose flying activities most suitable to the wind conditions. Which of the flying activities can they do on this day?

YOU SHOULD HAVE:

1 fan with speed set at high
1 map outlined with masking tape show a field that is 300 metres long
1 wind speed indicator
1 wind speed chart for different flying activities

INSTRUCTIONS:

- The masking tape shows where the field is located.
- The fan simulates the wind blowing over the field—turn the switch to high (3).
- Which flying activities can Peter and Jane do safely?
- Turn the fan off when you are finished.

Activity	Wind Speed Range
Model rocketry	0 to 5 km/h
Glider flyer	6 to 14 km/h
Kite flying	15 to 35 km/h

This solution was scored "At the Standard of Excellence."

Commentary

The problem is analyzed and clearly understood. A detailed plan is established and different locations are tested. The conclusions reached are exact for the wind speeds recorded from different areas of the field.

All interpretations and the explanations are clear, coherent, and logically connected. The data is presented in an organized format.

Activity 6—Rockets, Gliders, and Kites

Follow the instruction sheet at this station

1. Describe how you used the wind speed indicator and what information it gave you.

When the indicator was as close as possible the wind speed was about 20 km/h. When the indicator was as far as it was allowed to the wind speed was about 5 km/h and when it was in the middle the wind speed was about 10 km/h.

The wind speed indicator told me that kite flying was best when you are close to the fan (or wind), Glider flying was best in the middle of the field (or table) and that model rocketry was best on the far side of the field (or table).

2. Which flying activities can Peter do on this day and where they can be done? Give your reasons.

Peter can fly his kite close to the fan (or wind), he can go gliding in the middle of the field and he can do model rocketry on the far side of the field.

33

This solution was scored "At the Acceptable Standard."

Commentary

The task is understood. The answers indicate that a strategy is developed which supported appropriate conclusions.

The interpretations and explanations are organized, clear, and coherent. The ideas are logically connected.

Activity 6—Rockets, Gliders, and Kites

Follow the instruction sheet at this station

1. Describe how you used the wind speed indicator and what information it gave you.

I used the wind speed indicator to test what the highest wind speed was. It gave me information on how good each activity would work

2. Which flying activities can Peter do on this day and where they can be done? Give your reasons.

The activities they could have done would be Model rocketry, Glider flying and kite flying. My reasons for choosing all these are because they could fly rockets 5 km wind speed and the highest speed is 15 to 20 km. They could do Glider flying because it takes 6 to 14 km to fly one. And they could do kite flying because it takes 15 to 35 km wind speed but a kite wouldn't be very strong if the wind speed is only 15 to 20.

This solution was scored "Not Yet At the Acceptable Standard."

Commentary

The task is partially understood because the purpose of a wind speed indicator is recognized. The conclusions are not necessarily connected to a strategy.

The explanations are not too clear and data is limited.

Activity 6—Rockets, Gliders, and Kites

Follow the instruction sheet at this station

1. Describe how you used the wind speed indicator and what information it gave you.

You use the wind speed indicator by holding it and take a flying activity and measure how fast it goes It gives the indicator the number of km/h it goes

2. Which flying activities can Peter do on this day and where they can be done? Give your reasons.

Peter can take his kite to the large field let the wind take it through the air. We can also do glider flying on a windy day.

Observations Regarding Students' Skills and Knowledge

Students who participated in the performance-based assessment were motivated and stayed on task for up to two and one-half hours. Most students required approximately three to five minutes to read each problem and decide upon a strategy to solve it. Students were reminded it should take approximately 15 minutes to complete each station. Those who were having difficulty getting started were encouraged to move on to another station.

At some of the schools, students who had not participated in the assessment wanted to know if they could at a later date.

The following is a description of what students could do, followed by a discussion of areas for improvement. Information from the descriptive scoring results (see Appendix C) was used for this analysis.

What Students Could Do

Activity One—Tree Trunk

When making observations of the cross section of the tree trunk, 3 out of 5 students could make 3 or more observations. Two out of five students made appropriate inferences. When calculating the age from the number of growth rings, 7 out of 10 students were accurate to ± 5 years. About 1 out of 3 students made appropriate inferences about the health and growing conditions of the tree and almost all students could provide a location in which the tree might be found.

Activity Two—Ecosystem Mystery

The majority of students could make three or more appropriate observations from the mystery sample. About 3 out of 5 students made appropriate inferences. The students who made appropriate inferences clearly identified observations and inferences. Most of the students were able to predict the direct circumstances of the mystery using the stated observations. The majority of students attempted to provide a story in a logical time sequence. Students used the appropriate language in describing environmental situations and 9 out of 10 students used a written response format. Three of five students used effective problem solving skills and one half of the students' communication was scored at the acceptable standard.

Activity Three—Leaky Faucet

Approximately 3 out of 5 students measured volume of water lost in a unit of time and collected water for a period of one minute. One quarter of the students calculated water loss for 4 minutes which provided more accurate data for further calculations. Almost 3 out of 4 students attempted to calculate the water loss over a 24 hour period. This suggests students have an understanding of a controlled experiment that would constitute a "fair test." The majority of these students used the data to determine the amount of water lost and the resultant cost. About 2 out of 5 students were able to calculate a correct response.

Activity Four—Wiring a Train Station

Almost all students were able to demonstrate a completed circuit. Two out of three students were able to develop a workable strategy using a switch to connect and test the different lights while approximately 1 out of 7 students completed the initial circuit without a switch. Approximately one-half of the students correctly labeled the diagrams to help explain the workings of the circuit. Over 70% of the students used acceptable problem solving and communication skills to meet the requirements of the problem

Activity Five—Musical Instrument

A large majority of students created three or more sounds with 70% using the concept of differing lengths of bands to create these different sounds. About 20% of the students showed evidence of appropriate use of the different types of bands to produce different sounds. About one third of the students used a bridge appropriately to produce different sounds. The majority used diagrams with a written description for the task. About 75% of students used effective problem solving strategies and 3 out of 5 were able to communicate this information logically and clearly.

Activity Six—Rockets, Gliders, and Kites

Approximately 2 out of 5 students measured wind velocity in one location only and 3 out of 10 took measurements in three locations. Most students only took one measurement in a location. Seven out of twenty students accurately interpreted the information to decide which outdoor activities were possible in different wind situations. The majority of students communicated the information appropriately and clearly. Approximately one-half of the students used effective problem solving strategies and 2 out of 3 communicated the information clearly.

Areas for Improvement

Activity One—Tree Trunk

Although students made appropriate observations and inferences, most were unable to distinguish between them. Students demonstrated this confusion by listing observations as inferences and inferences as observations. Many inferences were not connected to observations. Students need to realize that good observing requires them to gather information with all the senses, then study the observations to draw inferences. When predictions are made in open-ended problems, assumptions about the environment must be included in the explanation. About 3 out of 5 students did not communicate information logically and clearly.

Activity Two—Ecosystem Mystery

Students need to make careful observations to determine logical sequences of events so appropriate inferences are made. Important components of the story were overlooked as sequencing was not appropriate or was missing. The language of science was not used appropriately in almost half of the sample. The concept of an ecosystem where several species interact was not identified. Students did not suggest that the area could be a wetland ecosystem or

that there could be evergreen trees growing in the region. Only 3 out of 20 students used all of the observations effectively within their story.

Activity Three—Leaky Faucet

The majority of the students had difficulty with multi-step mathematics and converting from one unit of measurement to another (i.e., mL to litres and minutes to hours). In some instances students used an unrealistic time frame for solving the problem. About 2 out of 5 students had difficulty calculating the volume for a 24 ho... period based on the volume measured for 1 to 4 minutes. There were very few students who used diagrams to support the written response. Of the students using a calculator for this question, only 1 out of 4 students used them appropriately. Many student answers were calculated to unrealistic proportions.

Activity Four—Wiring a Train Station

Many students were not able to construct or could not remember how to construct a parallel circuit. Students need to know how electricity travels through a wire in a closed circuit and how short circuits occur in their model. Diagrams were used to represent student constructed circuits and were not used for planning purposes. There were numerous students using diagrams which would short circuit if used in a real life situation. It was obvious that many students were unable to troubleshoot and correct the diagrams. In these cases the switch was used in a reverse manner that is when the switch was open the circuit was complete but when the switch was closed a short circuit developed and the lights would go out. Two out of five students were either unable to connect series circuits correctly or did not attempt a series circuit.

Activity Five—Musical Instrument

This activity was well done by students; however many students did not effectively use all of the variables at their disposal. Approximately 1 out of 4 had difficulty with problem solving and 2 out of 5 students' interpretations and explanations were unclear, incomplete or inaccurate. Many students provided confusing diagrams which may have added to their difficulty when explaining how different sounds were produced. A students were given more materials than they needed to construct the musical instrument, some students attempted more complex constructions that did not perform as well or not at all.

Activity Six—Rockets, Gliders, and Kites

Many students did not recognize the need to check wind conditions in three locations in order to determine which of the flying machines or activities would work. Less than one percent of the students used graphs, charts of tables to help with communicating the information and less than 3 percent used diagrams. Preparation of charts or graphs will help students to focus and draw inferences and conclusions. When students make predictions in open-ended problem-solving situations, assumptions they make about the situation should be included in their explanation.

Appendices

Appendix A

Science Holistic Scoring Criteria

Level	Problem Solving/Inquiry	Communication
3 Level of Excellence	—Analyzed and readily understood the task —Developed an efficient and workable strategy —Strategy implemented effectively —Strategy supported a qualified solution —*Appropriate application of critical knowledge*	—Appropriate, organized, and effective system for display of information or data —Display of information or data was precise, accurate, and complete —Interpretations and explanations logical and communicated effectively
2 Acceptable Standard	—Understood the task —Developed a workable strategy —Strategy inferred (some evidence) but not always clear —Strategy supports appropriate solution —*Evidence of application of critical knowledge*	—Appropriate, organized system for display of information or data —Display of information or data is mostly precise, accurate, and complete —Interpretations and explanations logical and mostly clear
1 Does Not Meet the Acceptable Standard	—Partially understood the task —Appropriate strategy some of the time —Possible evidence of a plan, but not clear —Partial connection to appropriate solution —*Partial evidence of application of critical knowledge*	—System for display of information or data may not be clear or effective —Display of information or data was somewhat precise, accurate, and complete —Interpretations and explanations somewhat clear
0 Insufficient	—Misunderstood the task —Inappropriate, unworkable strategy —No evidence of carrying out a plan —No connections to solution —No evidence of critical knowledge —Blank	—Disorganized system for display of information or data —Display of information or data was not precise, accurate, or complete —Interpretations and explanations not clear —Blank

Appendix B

Percentage of Students at Each Level

These provincial results show the percentage of students demonstrating the different levels of performance for problem-solving and communication skills.

	Performance Level	Activity					
		1	2	3	4	5	6
Problem Solving	3	16.2	15.0	13.3	32.7	25.6	25.0
	2	39.6	44.5	19.2	38.1	49.5	29.3
	1	43.0	37.2	56.9	25.6	23.1	42.8
	0	1.2	3.3	10.6	3.6	1.8	2.9
Communication	3	12.3	14.1	9.4	32.7	18.9	22.7
	2	30.6	34.6	18.5	40.8	41.5	42.3
	1	49.5	40.4	43.3	21.2	28.4	30.8
	0	7.7	10.9	28.9	5.3	11.2	4.2

3 Level of Excellence
2 Acceptable Standard
1 Not Yet At the Acceptable Standard
0 Insufficient

Appendix C

Science Descriptive Coding Criteria

Activity 1—Tree Trunk

Implementation

5.0%	no response
15.4%	at least 1 observation
18.6%	at least 2 observations
21.3%	at least 3 observations
18.9%	at least 4 observations
19.8%	more than 4 observations
0.5%	any other appropriate response

13.3%	no response
23.9%	at least 1 supported inference
21.5%	at least 2 supported inferences
17.9%	at least 3 supported inferences
12.3%	at least 4 supported inferences
9.7%	more than 4 supported inferences
0.8%	any other appropriate response

Solution

12.0%	no response
16.8%	age is correct (± 5 years)
49.2%	age and year are correct (± years)
21.5%	any other appropriate response

Question 2

18.5%	no response
49.2%	appropriate response
26.0%	appropriate supported response
5.7%	any other appropriate response

Question 3

16.0%	no response
49.5%	appropriate response
29.7%	appropriate supported response
4.1%	any other appropriate response

Question 4

12.3%	no response
69.6%	appropriate response
11.3%	appropriate supported response
4.4%	any other appropriate response

Communication Skills

11.2%	no response
38.7%	observations and inferences are integrated
46.3%	observations and inferences are separate

Activity 2—Ecosystem Mystery

Implementation

4.7%	no response
4.1%	at least 1 observation
11.0%	at least 2 observations
26.0%	at least 3 observations
26.5%	at least 4 observations
26.9%	more than 4 observations

14.7%	no response
13.0%	at least 1 supported inference
14.2%	at least 2 supported inferences
21.0%	at least 3 supported inferences
19.7%	at least 4 supported inferences
16.2%	more than 4 supported inferences

Solution

Question 1

52.6%	no response
29.3%	wet area
16.3%	not a wet area

Question 2

43.9% no response
44.3% trees in area
10.6% no trees in area

74.3% no response
5.1% evergreen trees
19.1% no evergreen trees

Activity 3—Leaky Tap

Implementation

32.5% no response
7.1% collected less than 1 minute
31.2% collected for 1 minute
4.5% collected for 1–2 minutes
3.65 collected for 3–4 minutes
13.0% collected for more than 4 minutes
7.6% any other appropriate response

19.5% no response
73.7% measured per unit time
6.8% did not measure per unit time

18.5% no response
59.6% measured time per unit volume
12.9% did not measure per unit volume

Solution

Question 1

61.6% no response
22.1% measurement is reasonable (< ± 10%)
6.8% measurement is reasonable (10% > < 20%)
9.2% measurement is reasonable (20% > < 30%)

Question 2

59.9% no response
20.7% calculation for 24 hours is correct (< ± 10%)
14.8% calculation for 24 hours is correct (minor error)
4.5% any other appropriate response

Question 3

61.9% no response
12.7% calculation is correct
18.9% calculation is correct (minor error)
6.5% any other appropriate response

Communication Skills

5.9% no response
93.5% written response
0.5% no written response

18.8% no response
27.8% calculations complete
53.3% calculations not complete

99.4% no response
0% diagrams are appropriate
0.5% diagrams are not appropriate

32.4% no response
24.2% used calculator appropriately
43.3% did not use calculator appropriately

Activity 4—Wiring a Train Station

Solution

Question 1

10.9% no response
65.4% working light with switch
15.4% working light without switch
8.0% any other appropriate response

Question 2

87.3% no response
3.0% parallel circuit (complete)
4.2% parallel circuit (partial)
4.7% any other appropriate response

19.4% no response
63.5% series circuit (complete)
9.4% series circuit (partial)
7.0% any other appropriate response

Communication Skills

3.0% no response
45.2% diagrams with labels
49.6% diagrams without labels

12.1% no response
14.4% diagrams with symbols
71.6% diagrams without symbols

Activity 5 Rockets, Gliders, and Kites

Strategy

3.0% no response
41.3% took measurements in at least 1 place
10.9% took measurements in at least 2 places
29.3% took measurements in at least 3 places
12.3% took measurements in more than 3 places
2.9% any other appropriate response

Implementation

4.5% no response
83.1% took at least 1 measurement per place
3.6% took at least 2 measurements per place
6.2% took more than 2 measurements per place
2.1% any other appropriate response

Solution

3.2% no response
36.5% can fly one machine
21.9% can fly two machines
36.3% can fly three machines
1.8% any other response

Communication Skills

98.8% no response
0.5% used chart/table/list appropriately
0.2% did not use chart/table/list appropriately

99.5% no response
0% used a graph appropriately
0% did not use a graph appropriately

96.5% no response
2.7% used a diagram appropriately
0.3% did not use a diagram appropriately

2.1% no response
81.4% used a written response appropriately
15.7% did not use a written response appropriately

98.6% no response
0.5% used other methods appropriately
0% did not use other methods appropriately

Activity 6 Musical Instrument

Strategy (Implementation)

4.2% no response
88.5% uses different lengths appropriately
6.8% does not use different lengths appropriately

71.1% no response
26.3% uses different types appropriately
2.0% does not use different types appropriately

59.3% no response
37.8% uses bridge appropriately

2.3% does not use bridge appropriately

Solution

Question 1

3.0% no response
2.3% instrument that makes at least 1 sound
8.3% instrument that makes at least 2 sounds
57.3% instrument that makes at least 3 sounds
28.0% instrument that makes more than 3 sounds

Question 2

25.9% no response
68.8% uses different lengths appropriately
4.8% does not use different lengths appropriately

77.6% no response
20.6% uses different types appropriately
1.4% does not use different types appropriately

64.9% no response
33.4% uses bridge appropriately
1.2% does not use bridge appropriately

Communication Skills

11.8% no response
42.8% diagrams with labels
44.3% diagrams without labels

17.1% no response
38.3% description for each instrument change
34.3% some description for instrument changes
9.4% no description for instrument changes